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A RE-DESIGN OF THE YARDS OF THE
ILLINOIS CENTRAL RAILROAD AT
CHAMPAIGN, ILLINOIS

BY

PIERRE JOSEPH PELOQUIN

AND

RUPERT JOHN SERCOMBE

THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN

RAILWAY CIVIL ENGINEERING

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Pierre Joseph Peloquin and Rupert John Sercombe

ENTITLED A Re-design of the Yards of the Illinois Central

Railroad at Champaign, Illinois.

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF B.S. in Railway Civil Engineering.

Francis S. Foote Jr.

Instructor in Charge

APPROVED: Edward C. Schmidt

HEAD OF DEPARTMENT OF Railway Engineering

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RE-DESIGN OF ILLINOIS CENTRAL
RAILROAD YARDS AT
CHAMPAIGN

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I N T R O D U C T I O N

Champaign is situated in the east central part of Illinois, 128 miles from Chicago, upon the Illinois Central, Big Four, and Wabash railroads. It is not a manufacturing city as there are only a few small factories and for that reason local freight traffic is not very heavy. Champaign is very closely united with another city, Urbana, to the east. The two cities are so closely connected that they may be considered as one, as respects local freight traffic from Chicago, which may be sent on the Illinois Central. The combined population of the two cities was about 20,000 in 1910. Champaign is a mid-division point of the Illinois Central and, therefore, a freight terminal to take care of the divisional change. The Illinois Central handles here more business than the other roads entering Champaign, as only a small branch of the Wabash reaches this town, and this division of the Big Four, though it has shops at Urbana, does not handle traffic equal in volume to that of the Illinois Central, which is a main line. In 1908, the whole Illinois Central system moved 25,047,062 tons of freight, a total of 6,038,541,933 ton miles, so that it can be seen that the line is of some importance in the Central Mississippi Valley. Champaign is the last point to change engines before reaching Chicago, and must handle all the through traffic from the south.

Importance of Terminals.

The importance of terminals in the handling of freight.

as a rule, is underestimated. About 75 percent of the railroad's receipts are obtained from its freight traffic. A considerable portion of the time necessary to transfer a car of freight from one point to another is spent in the yards of intermediate divisions. Anything that will hasten the passage of a car through yards will mean that it will get to its destination sooner and thereby leave room for more rolling stock and more revenue. The trouble with some of the freight yards is that they have been formed as the traffic grew and hence are little more than a group of tracks with little systematic arrangement. One thing to observe in purchasing land for freight yards is to obtain a surplus in the first place. Industries are sure to spring up along a railroad company's right of way and if in a few years conditions become cramped, the difficulty of obtaining additional land will have increased enormously. The moral of this is to spend a good deal of time and money in laying out a yard which will take care of traffic for years to come in an economical manner. There are many other things to notice in designing a yard but they really all concentrate to the one idea of getting shipments from one destination to the other with as little delay as possible. Congestion in terminals is the great bug-bear of the yard-master. Every time a car is backed up it means a loss of time and money. The cardinal rule in yard design is to keep the rolling stock always moving forward. An example will show that there is a large allowable expenditure in building yards so as to do away with all the yard engines possible. On one of the Eastern roads in 1904, according to

MacCart in Engineering News, March 15, 1906, the total cost of running a switching engine one mile was 32.6 cents and an average run of 144 miles per day would make \$46.94. With 313 working days in the year, this would make \$14,692, or the interest at 5 percent on \$293,845. This last amount is the allowable expenditure which could be put into improvement on the yard so that one switching engine could be cut out.

Kinds of Freight Yards.

There are three types of freight yards in use at the present time, namely, the "push and pull," "poling" and "gravity" types. The method which is most economical, of course, varies with the local conditions and volume of traffic. The "push and pull" method is probably the most common and consists simply of having an engine do all the switching necessary for separating and classifying cars. A "poling yard" is one in which the cars are moved by a pole operated by an engine on a parallel track. A "gravity yard" is one in which the movement of the cars in classifying is produced by pushing them over a hump, and allowing gravity to run them down into the ladders and body tracks. The latter yard requires a number of men as riders and switch-throwers, but a great number of cars can be handled in a short time; about 150 cars per hour is a good average. Unless there is enough traffic to keep the men busy, the gravity yard will not be economical and for that reason most of the division points use the "push and pull" method. The Champaign yards

are used for so little classifying that the hump yard could not be considered as economical, and the ordinary "push and pull" is used.

Position of Mains.

The question of where to put the yards in relation to the mains is an important consideration. If possible it is the best practice to run the mains around each side of the yards for then they are always free from switching movements. In doing this ample room must be left between the mains for future growth. Connections with the main lines should be a minimum and should be arranged so that the mains will not be fouled by switching movements. If, for some reason, the mains cannot be put in this position, the next best plan is to put both at one side. This method is objectionable because it causes freight trains moving in one direction to cross the high speed passenger tracks when moving in or out of the terminal. The last method, that of putting the mains through the center and the yards on both sides, though said to be the worst practice, is followed in the majority of average-sized freight terminals. Accidents are more likely and there is always a certain amount of crossover movements necessary. This latter plan is used in the Champaign yards, and it has been decided that they will not be changed in the re-design. To put the roundhouse, coaling pits, etc., in the center and to spread the mains would take more space than is now occupied. To be sure, the present mains could have been used as body tracks, but putting the roundhouse inside

would have meant a considerable amount of track rearrangement. Therefore, the two mains will remain where they are.

Division of a Terminal.

A complete terminal is divided into receiving yards, separating yards, classification yards, and departure yards. All terminals do not have these divisions sharply separated and one ladder with its body track may serve for the whole layout. In the receiving yard the engine and caboose is cut off, and the train left until ready to be broken up. In the separating and classifying yards, the cars are taken in lots of one or more and formed into other trains bound for further points. There are two general ways of classifying cars; by commodities and by point of destination. Through trains can be made up at a large terminal which will go through several division points without stopping excepting for change of engines. Trains also can be made up of such commodities as wheat, coal, fruit, etc. The question as to whether through or mixed freights will be sent out from a terminal is rather important. By sending a through freight, there will be no intermediate switching for several divisions and time will be saved. But, on the other hand, in order to get a full train bound for a certain locality may mean holding cars for several days in the terminal which means a loss of interest on capital to say nothing of the dissatisfaction of the consignee. Large terminals usually have enough cars to make up through trains, but division points of medium size must send

out mixed trains in order that the yards will not get too congested. After the train has been made up, it is pulled over to the departure yard and there waits for orders to leave for its destination.

Traffic at Champaign.

In order to design the different parts of a terminal, the traffic which has to be handled must be known. Following is the traffic at the Illinois Central Champaign Yard:

Number of passenger trains per day both ways, (average)	14
" " freight " " " " " "	35
Average number of cars per freight train	60
" " " " " passenger "	6
Maximum length of freight train - cars	75
Number of men working in yards	32
Number of engines working in yards - Day	3
Night	2

The traffic does not warrant having all the separate yards given above. In fact, there are only the two yards, that on the west side of the mains for south bound freights, and that on the east of the mains for north bound freights. Then there is really the one yard acting as a receiving, classifying, separating and departure yard. The loaded cars are nearly all north bound, while the south bound consist principally of empty coal cars and box cars. For the south bound trains, there is practically no separating or classifying. The empty gondolas are

bound for points further south and sometimes the trains simply go into the yard, change engines, and pull out again. In case there are any cars for the Big Four or Wabash, they are dropped off at the yard and taken back over the mains to the transfer point. On the north bound side, there is more classification, both for traffic to be turned over to the Big Four or Wabash and also some arrangement of the cars which are to be dropped off on the way to Chicago. Taking it altogether, however, there is comparatively little classification done in the yards, for at a mid-division point, their chief service is to furnish a point for trains to change engines. There is no classification whatever into commodities, though frequently whole trains come in, loaded only with coal, going north.

Change in Tracks

The present traffic keeps the yard full nearly all the time so that in the re-design, one body track has been added to the south bound yards and two to the north bound. In addition to this, 400 feet has been added to each of the body tracks of both north and south bound yards. The tendency is to increase the number of cars per train and in order to have each body track hold a train of maximum length, they must be lengthened. The capacity has also been increased by adding a 2600 foot lead track, both incoming and outgoing for both yards. The two outgoing leads act as small departure yards and the incoming as storage yards. At present, if the yards are full, an incoming freight must wait upon the main track until room is made for it.

Sometimes as many as three trains have been held up for this reason. This is very objectionable for, in case a passenger train were due, there would be no convenient way to remove the freight. A lead track is always supposed to stay open and not to be used for switching purposes. Therefore, a freight, unless following very closely another section, is sure of being able to get out of the way of any superior train. In exceptional cases the yard and leads may be full, but at any rate the leads have furnished room for two more trains. The incoming lead of the north bound yard, and the outgoing lead of the south bound yard are to be obtained by four tracking the line for the requisite length. The other two leads are to be formed by swinging the mains and using one of the present mains and one of the present local freighthouse tracks for the purpose. This change would necessitate the relaying of a short distance of main track.

Roundhouse and Accessories

The location of the roundhouse in a divisional freight yard is important. All the trains change engines and crews at these points and it is desirable that this change may be made quickly as possible. In order that this may be done, the location of the roundhouse should be as near as practicable to the point where the locomotives pull in. The present location of the roundhouse at Champaign is certainly not a good one. First, it is too near the City of Champaign and the noise and dirt, that is necessarily present, is so objectionable to the citizens that

they are demanding its removal. If it is to be moved at all, it will, therefore, have to be taken further from the heart of the city. The other objection to the present location is its proximity to the Big Four and Wabash tracks. The crossover which enables an engine and cars to run into the roundhouse or on to the coaling trestle is scarcely 50 feet from the Wabash crossing and about 80 feet from the Big Four. It is evident then that nearly every time an engine is to enter the roundhouse or surrounding tracks, the towerman must set the signals at danger upon the tracks that are crossed. As there is a number of train movements in the vicinity of a roundhouse, it is evident that this is no small disadvantage. In the re-design the roundhouse is to be located at the south end of the yards so as to be easily accessible to the ladders of both north and south bound yards. There would be a short run for engines from freights in either direction and, though passenger engines would have considerably further to go, they form a minority of the traffic. The position was chosen because it eliminated the faults given above and because there is comparatively little fill necessary. The roundhouse has 19 stalls instead of 18 as the present one has, and the length of the stall has also been increased. The turntable is 70 feet across. The accessories of the roundhouse have been changed in position somewhat. The coaling trestle with a capacity of 300 tons is to be at the north side of the roundhouse. Near the trestle is to be a complete oil house and sand house and water tank. The ash-pits are to have a depressed track into which the ashes can be shoveled from the floor under the supported engine tracks. The

details are to be arranged so that ingoing engines could drop their ashes, take coal, and run into the stalls to be cleaned, while outgoing engines could get their coal, sand, and water as they passed out. To the south of the roundhouse, are to be the engine storage tracks and bad order and repair tracks. These should be located close to the roundhouse on account of the nearness of the machine shop and tools necessary for repair. The engine storage tracks would hold 20 locomotives and with the 19 roundhouse stalls, gives room for 39 locomotives in all.

Freight House

The freight house as located at present has only two tracks for unloading and any switching that is necessary must be done upon the two mains. It is also crowded for storage room and does not give sufficient floor space. In the re-design it is to be shifted from its present position to the location now occupied by the roundhouse. The platform space is to be made 16,300 square feet by running three pairs of tracks into the platform side and unloading from each. There are to be enough extra tracks so that all necessary switching can be done without blocking up the mains. The local freight must be brought up from the yards upon the mains, a distance of about one mile, but the freight house must be near the city center and a short haul cannot be eliminated. In the remaining territory left vacant by the roundhouse, team tracks are to be placed, as there is a good opening to the street from behind. These tracks are to have paved teamways which facilitate freight handling in

bad weather. The additions would make a team-trackage capable of handling about 50 cars. A coal chute of 450 tons for local service is also to be located near the team tracks.

Grade Reduction

Beyond the south end of the yards under discussion, there is a grade varying from 0.3 to 0.7 percent for about 1800 feet. Heavy freight trains have some difficulty in pulling over this grade as they have no velocity head to aid them. To reduce this grade to a level would make the start from the yards much easier. The comparative quantities which would be obtained are as follows;

Earthwork

Cutting down grade and putting in the two leads,

Cut - - 44,000 cubic yards

Fill - - 1,276 cubic yards

To put in leads without cutting down grade,

Cut - - 6,000 cubic yards

Fill - - 2,725 cubic yards

Besides this the improvements in the yards would require 17,450 cubic yards of fill. By putting in the leads and cutting down grade, approximately 24,000 cubic yards more dirt would have to be moved than if the grade is not changed. The following computation is upon the basis that a fill within the short distance of haul will not cost anything when there is an equal amount or

or more of cut. Taking excavation at 30 cents per cubic yard, the cost of reducing the grade is as follows,

24,000 cubic yards at 30¢	\$7,200
Shifting of track during reduction	
	<u>1,000</u>
Total	\$8,200

The 24,000 cubic yards is the amount of additional earthwork that must be removed over and above that which would have been moved if the leads had been put in without reducing grade. To have put in the leads would have required 2725 cubic yards of fill, which added to the fill at the yards themselves would make 20,175 cubic yards of fill. By reducing the grade there would be a total of 44,000 cubic yards of cut necessary. The difference between the 20,175 cubic yards of fill and 44,000 cubic yards of cut would give 24,000 cubic yards (in round numbers) of earthwork, excess to be handled by the reduction of grade.

Taking the grade as similar to Wellington's class C, the saving obtained would be as follows;

Factor of saving for each foot of rise per daily train per year is estimated at \$3.00. The amount of rise and fall to be saved is 6 feet.

$$\$3.00 \times 35 \times 6.0 = \$630 \text{ per year.}$$

Capitalized at 5 percent, there would result

$$20 \times \$630 = \$12,600$$

allowable expenditure to take out 6 feet of rise and fall.

It is therefore recommended that the grade be eliminated.

Costs

Now that the plans of the general re-design have been decided upon and the drawings drawn to scale, the costs of the whole improvement will be considered.

These costs might be divided into four classes:

1. Cost of right of way.
2. Cost of grading, cuts and fills, with the lowering of the south end grade.
3. Labor and track material, including ballast, ties, rails and rail fastenings, turnouts and crossovers, fences, cattleguards, water and air pipes, etc.
4. Buildings, including coal chutes and sheds, water tank, turntable, ash pits, etc.

1. Right of Way.

Total new land to be bought = 470,000
square feet or

$$\frac{470,000}{43,560} = 10.76, \text{ say } 11 \text{ acres.}$$

Cost = 11 x 250 = \$2,750.00

2. Cost of Grading.

Since the volume of traffic does not justify

the actual expenses of building a gravity yard, the present cluster will be left on a level grade; the only grading will occur at the south end.

44,000 cubic yards earthwork at 30¢	=	\$13,200
Cost of grading, shifting track, etc.	=	<u>2,500</u>
Total		\$15,700

3. Labor and Material (track)

Cost of one mile of track.

Items	Unit	Unit Cost (Dollars)	No. of Units Required	Total Cost (Dollars)
Rails - 80#	Ton	\$28.00	125.71	\$3200.00
Sliced Bars	Cwt.	1.23	227.04	279.26
Bolts	Cwt.	2.83	24.12	68.26
Oak Ties (1st Quality)	Each	0.80	2168.00	2534.40
Spikes	Cwt.	2.20	70.40	154.88
Ballast(cinders)	Cubic Yard	0.30	1900.00	570.00
Tie Plates(1/3)	Each	0.11	2000.00	220.00
Labor				528.00
Miscellaneous				<u>125.20</u>
Total				\$8000.00

In case broken stone is used for ballast, the total cost per mile of track is

	\$8500.00
Broken stone ballast track - 1 mile at \$8,500	\$8,500.00
Cinder ballast track - 7 miles at \$8,000	56,000.00

Turnouts (complete in place) - 60 at \$250	\$15,000.00
Old track removed or shifted - 2 miles at \$528, about	1,057.00
Cattle guard (complete in place) 1 at \$25	25.00
Highway crossings - 1 at \$50	50.00
Fences - 3500 feet at \$0.025 per foot	88.00
Teamways paving (brick) - 10,000 sq. Yd. at \$3.00	30,000.00
Supply water pipes (8") - 66 tons at \$35	2,300.00
Air pipes (3" and 2"), complete outfit	3,000.00
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Track labor and material, Total Cost	\$116,000.00

4. Buildings.

Engine House, 19 stalls at \$2500	\$47,500.00
Turntable (70 ft.)	8,000.00
Oil House, complete	1,800.00
Sand House, complete	800.00
Power House, 2 boilers	5,000.00
Machine Shop (150 feet by 50 feet)	9,000.00
Car Repair Shop (100 feet by 45 feet)	1,500.00
Coal Sheds	500.00
Store and Office	1,200.00
Water Tank (capacity 30,000 gal.)	2,000.00
Coal Chutes: - one, capacity 300 tons	15,000.00
one, capacity 450 tons	20,000.00
Ash pits, depressed pits. 540 ft. at \$30	16,200.00

Pump Houses and Wells, 5 at \$600	\$ 3,000.00
Stand Pipes, 2 at \$450	900.00
Freight House, 100 feet by 45 feet	9,000.00
Freight platform, 16300 sq. ft. at \$0.35	5,700.00
Other small yard buildings	2,900.00
<hr/>	
Buildings, Total Cost	\$150,000.00

Summary.

1. Right of Way	\$ 2,750.00
2. Grading and Earthwork	15,700.00
3. Track Labor and Material	116,000.00
4. Buildings.	150,000.00
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Total \$284,450.00

10 percent for engineering

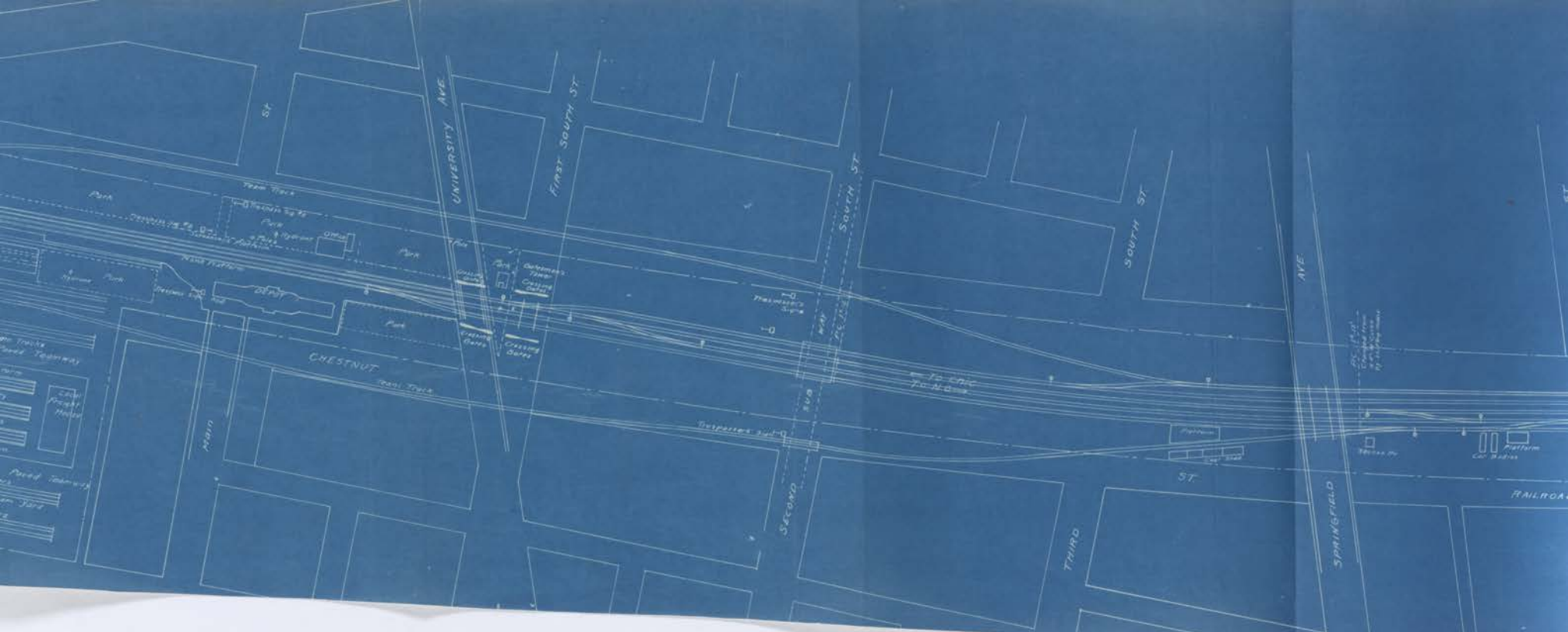
and other expenses 48,500.00

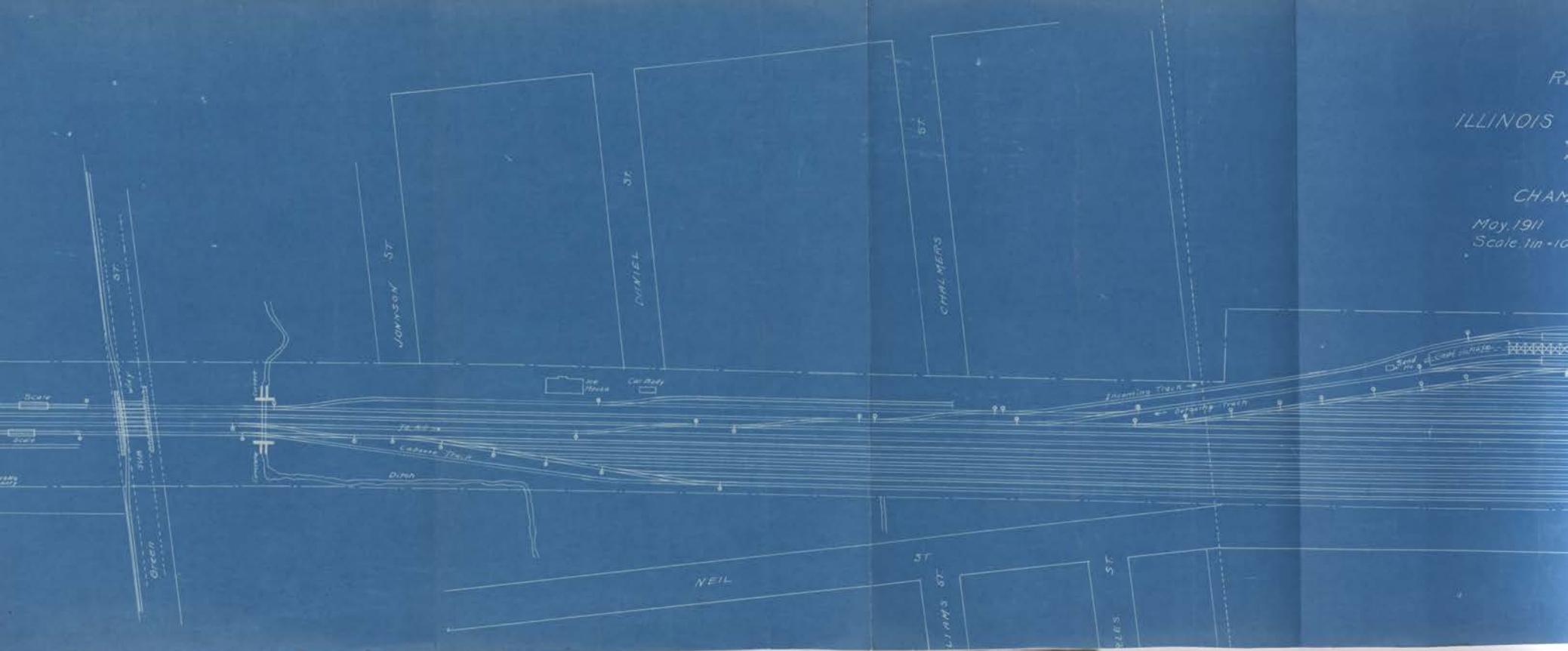
Grand Total \$313,000.00

C O N C L U S I O N

The cost of the proposed improvement has been given on the preceeding page. To give the amount of money saved in operation by the change is impossible. In the last few years the railroads have spent an enormous sum of money in changes that have not in themselves produced additional revenue. Safety devices, such as grade crossings, air brakes, etc., have cost money, but their benefit to the road's finances are not apparent upon the balance sheet. Larger and better terminals of all kinds must be built; the Pennsylvania has spent \$108,000,000 on New York terminals from which no additional income can be expected. Their saving cannot be computed as, for instance, the amount saved by reducing a ruling grade one percent. Therefore, the saving obtained from the proposed improvement cannot be expressed in allowable expenditure, but only by the increased efficiency and better foundation for a future increase in traffic. The essential advantages of the proposed design are the additional yard space provided, and the more convenient location of the roundhouse. With the four leads and the additional length of the existing body tracks, traffic could be handled more easily. The position of the roundhouse would facilitate the departure of freights as engines could be supplied with less delay than at present. The changes would concentrate the yards proper into more compact form than before, when the roundhouse was separated from the yard by a considerable distance.







P.
ILLINOIS

CHAM

May 1911
Scale 1 in = 10

RE-DESIGN OF THE ILLINOIS CENTRAL RAILROAD YARDS

AT
CHAMPAIGN, ILLINOIS

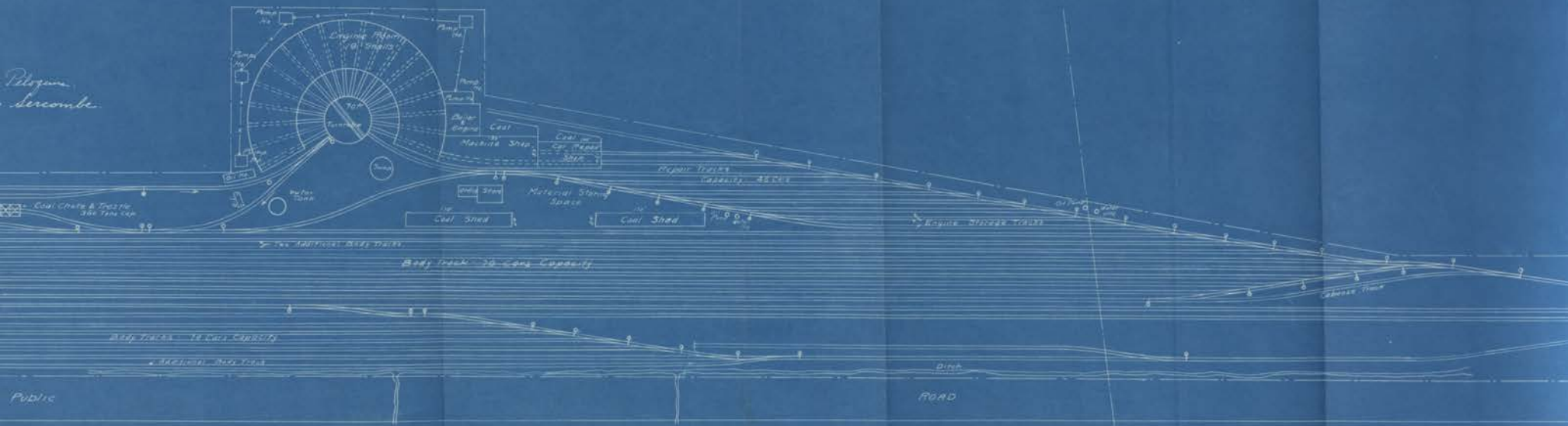
May, 1911
Scale 1 in = 100 ft

Paul Joseph Pelogum.
Rupert John Sercombe.



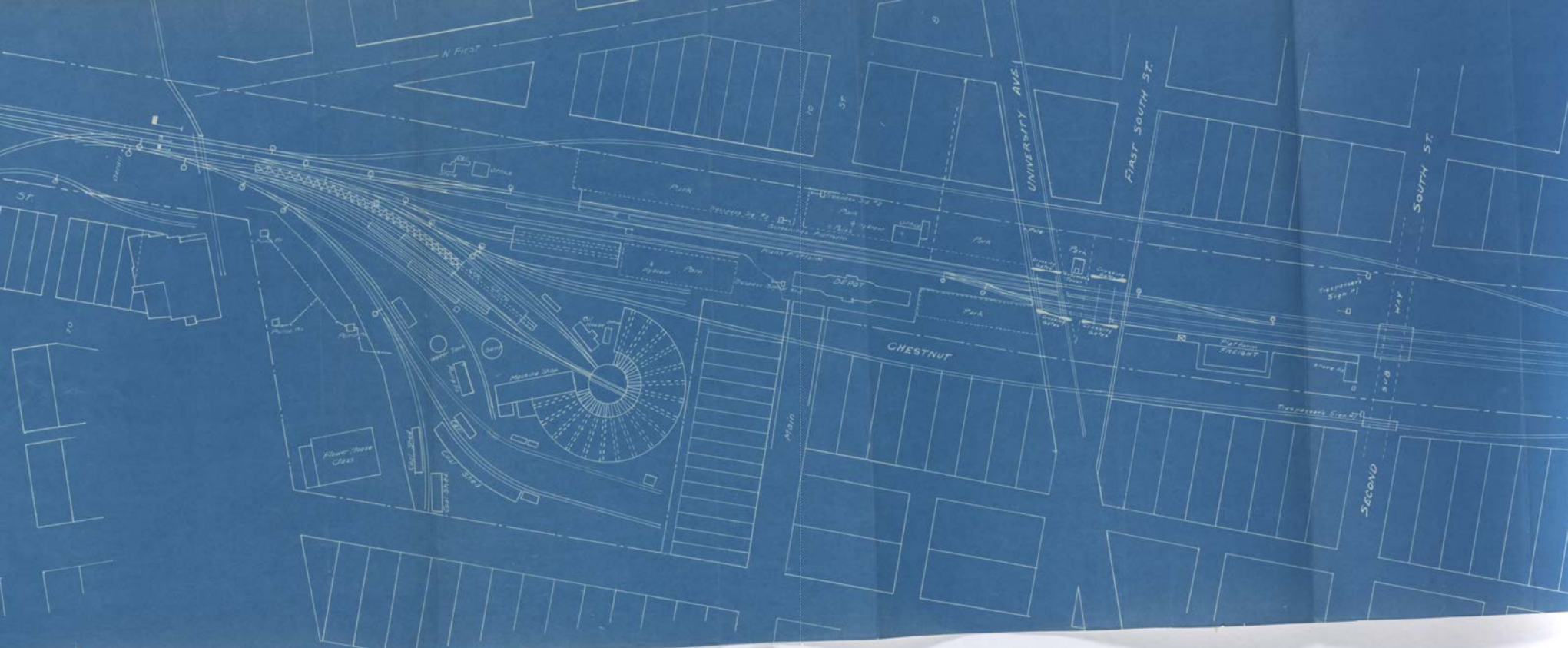
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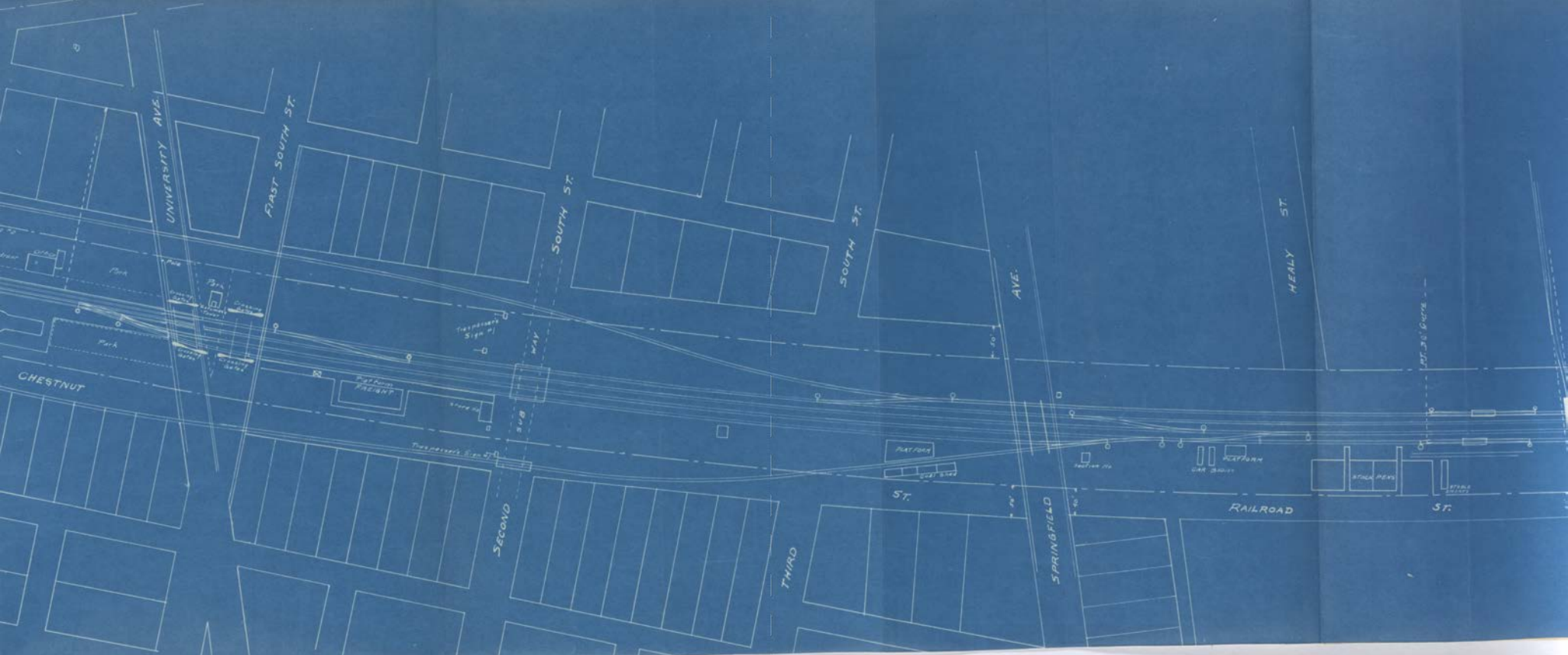
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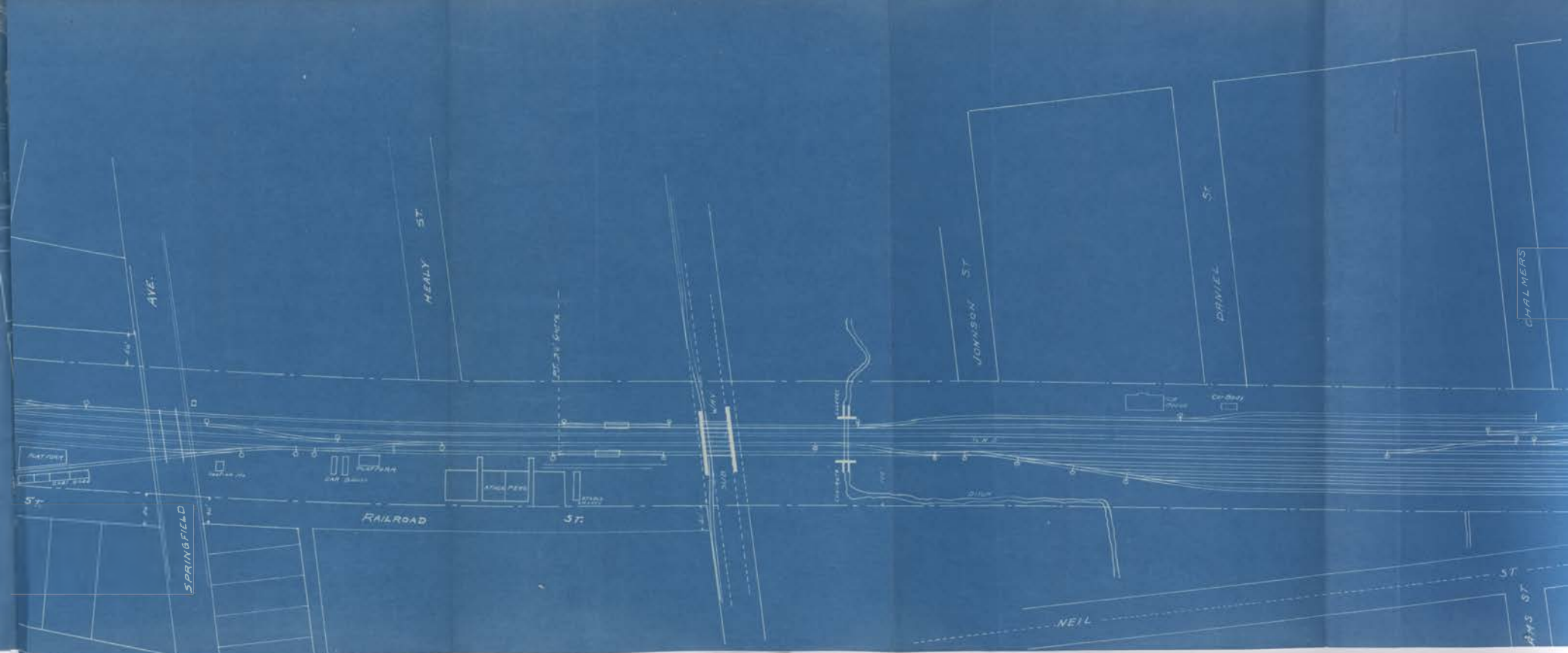


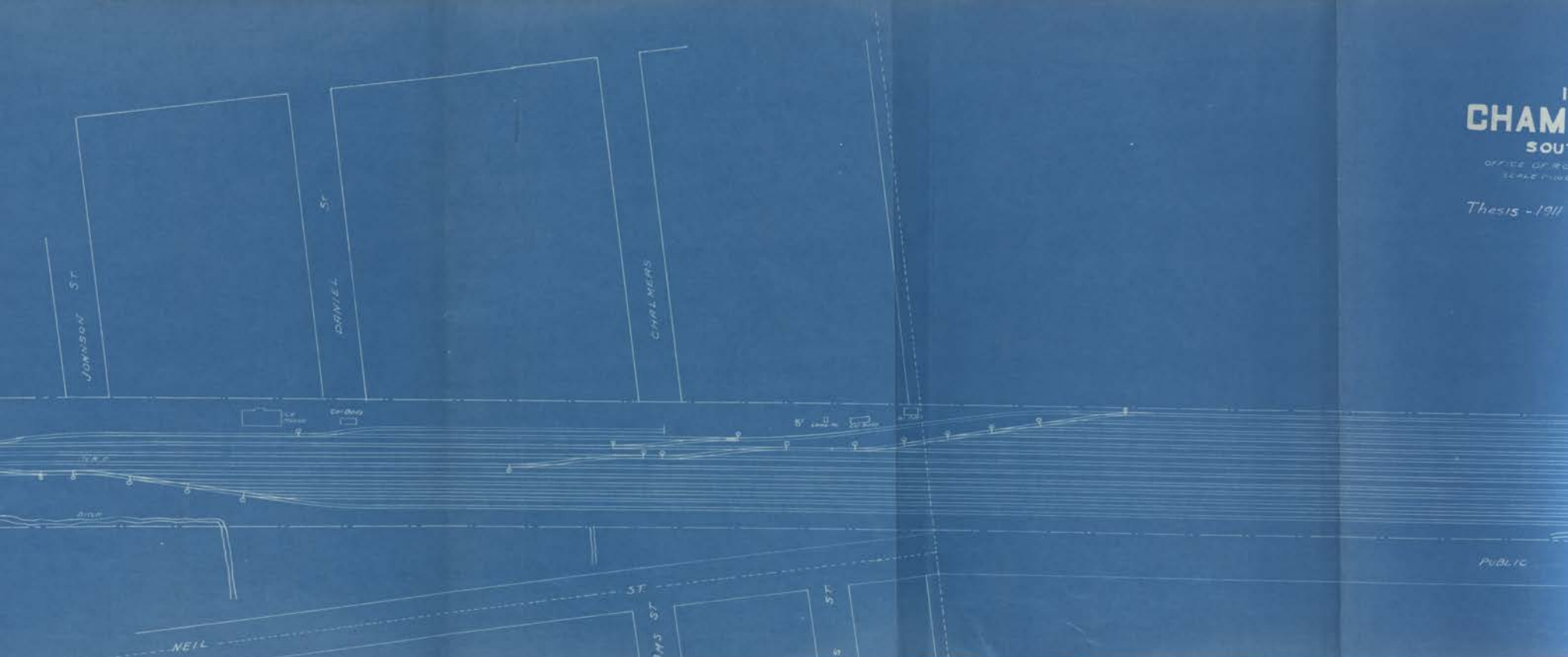
Proposed Re-Design











CHAM

SOU

OFFICE OF THE
SCALE 1/1000

Thesis - 1911

PUBLIC

I. C. R. R.
CHAMPAIGN.ILL.

SOUTH YARD AT,

OFFICE OF ROADMASTER, CHICAGO
Scale 1"=100' JUNE 12, 1907

*Thesis - 1911 - J.P. Peloguin
(R.J. Sercombe)*



Public

ROAD

